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IS 11473 (2002): Groundnut Decorticator - Test Code [FAD
20: Agriculture and Food Processing Equipments]



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भारतीय मानक
मूंगफली का छिलका उतारने की
मशीन — परीक्षण संहिता
(पहला पुनरीक्षण)

Indian Standard
GROUNDNUT DECORTICATOR — TEST CODE
(*First Revision*)

ICS 67.260

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BUREAU OF INDIAN STANDARDS
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NEW DELHI 110002

FOREWORD

This Indian Standard (First Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by the Agricultural Produce Processing and Milling Machinery and Surface Covered Cultivation Structures Sectional Committee had been approved by the Food and Agriculture Division Council.

Decortication of groundnut is an essential operation prior to consumption of kernel in any form. Decortication is the operation of breaking pods and freeing kernels from pods. Freed kernels from pods are to be separated from shell and undecorticated pods, with integrated separating units of the decorticator or in successive different operations with other separating equipment.

This standard was first published in 1985. The revision of this standard has been taken up to incorporate latest developments in the field. The revision incorporates among others the following:

- a) Detailed procedure for testing energy consumption during test at no-load and at load.
- b) Procedure for testing drudgery in operation in case of manually operated decorticator.
- c) Requirements of test material are modified and also moisture content for test material has been specified.
- d) Test procedure for test at load modified.
- e) Determination of preference of decorticator.
- f) Data sheet for performance test.
- g) Illustration of decorticators with or without cleaning device.

In the preparation of this standard, considerable assistance has been derived from Central Institute of Agriculture Engineering, Bhopal.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Indian Standard

GROUNDNUT DECORTICATOR — TEST CODE

(*First Revision*)

1 SCOPE

This standard prescribes the method for testing of groundnut decorticator.

2 REFERENCES

The following Indian Standards contain provisions which, through reference in this text, constitute provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below:

IS No.	Title
4333 (Part 2) : 1967	Methods of analysis for foodgrains : Part 2 Moisture
6894 : 1993	Malting barley — Specification (<i>first revision</i>)

3 TERMINOLOGY

For the purpose of this standard, the following definitions shall apply.

3.1 Pod — Unbroken shell with kernel(s) inside.

3.2 Kernel — Edible part of groundnut.

3.3 Shell — Outer hull of the pod.

3.4 Whole Kernel — Unbroken and undamaged kernel(s).

3.5 Broken Kernel — Wholly or partially damaged kernel(s).

3.6 Decorticated Kernel — Whole and damaged kernel(s) freed from pods by decortication.

3.7 Undecorticated Kernel — Kernel in undecorticated and partially decorticated pods after decortication.

3.8 Partially Decorticated Pod — Pod being left with kernel(s) in it after decortication.

3.9 Foreign Matter — Inorganic and organic material other than kernel, pod and shell which include sand, clay, mud, metal chips, weed and other grains.

3.10 Main Kernel Mixture, Sieve Overflow Mixture and Shell Mixture — The mixture received at the main kernel outlet, the sieve overflow-outlet

and the shell outlet.

3.11 Main Kernel Outlet — Outlet at which decorticated kernel moves out of the machine. In case of the machine without separating device, shells and undecorticated and partially decorticated pods also come out. In case of machine with blower(s), undecorticated and partially decorticated pods also come out.

3.12 Shell Outlet — Outlet at which broken shells come out of the machine in case of the machine with blower(s).

3.13 Sieve Overflow Outlet — Outlet at which undecorticated and partially decorticated pods come out of the machine, in case of the machine with sieve(s).

3.14 Capacity of Decorticator — Quantity of pods (feed) decorticated in the machine per unit time.

3.15 Decortivating Efficiency — Fraction of pods decorticated to the pods fed by weight as percentage.

3.16 Cleaning Index — It is expressed by the following formula:

$$\text{Cleaning index} = \frac{\text{Amount of undesirable material removed}}{\text{Total amount of undesirable material}} = 1 - (X_{dp}/X_{dt})$$

where

X_{dp} = fraction of undesirable material in the product with respect to absolute clean material, and

X_{dt} = fraction of undesirable material in feed.

3.17 Broken Percentage — The broken kernels received at all outlets with respect to total kernel output expressed as percentage by mass.

3.18 Kernel Pod Ratio — Ratio of kernel to pod expressed as percent by mass.

3.19 Separation Index — It is expressed by the following formula:

Separation index =

$$1 - \frac{S[(1-X_{ss})/(1-X_{sf})] + P(X_{sp} + X_{sf})}{S + P}$$

where

S = mass flow rate of separated material A,

X_{ss} = fraction of material A in S ,

X_{sf} = fraction of material A in feed ($S + P$),

P = mass flow rate of separated material B, and

X_{sp} = fraction of material A in P .

4 CLASSIFICATION

According to the use of different separating devices, decorticators are broadly classified into the following categories:

- a) Decorticator without separation device; and
- b) Decorticator with separation device:
 - i) Decorticator with blower(s), and
 - ii) Decorticator with blower(s) and sieve(s).

NOTE — Groundnut decorticator is also called groundnut sheller or peanut sheller.

5 SPECIFICATIONS OF DECORTICATOR

The manufacturer/supplier shall provide all the literature, operator's manual, instruction book, list of spare parts, recommended performance, working capacity, and specification sheet as given in Annex A.

6 PRE-TEST OBSERVATIONS

6.1 Identification of Variety

The groundnut for which test is to be done shall be assessed for its crop variety. At least two groundnut varieties of different sizes shall be selected for testing.

6.2 Determination of Quality

The groundnut pods which are to be used for decortication during the tests shall be free from foreign matter, namely, chaff, stones, metal pieces, mud particles, damaged pods and other agricultural grains. It should be graded before test. The storage period of the feed shall be reported.

6.3 Determination of Moisture Content

The groundnut pods and kernels shall be examined for moisture content in accordance with IS 4333 (Part 2). The moisture content shall be expressed in percent.

6.4 Determination of Kernel Pod Ratio

The ratio of kernel to pod in the feed shall be worked out by determining the mass of kernels obtained from unit mass of pods. For this purpose, five representative samples shall be selected and decortication shall be done manually for each sample. Average of five samples shall be taken as kernel pod ratio.

6.5 Determination of Size Variation

The length, width and thickness of groundnut pods in the feed shall be determined by using vernier calliper and shall be reported in mm. The mean size and standard deviation shall also be worked out.

6.6 Determination of Germination Percentage

Take 100 whole kernel as obtained from 6.4. The percentage of germination of the kernel should be determined in accordance with Annex B of IS 6894.

7 GENERAL TESTS

7.1 Verification of the Specifications

The specifications as declared by the manufacturer (*see 5*) shall be verified and reported in the specification sheet given in Annex A.

NOTE — The main objective of this test are to study and confirm the specifications and design comparing them with those given by the manufacturer and to undertake such study that will assist in modification and improvement of the machine design. Some of the items to be examined are:

- a) Design of decorticating unit,
- b) Mechanism of separating and cleaning,
- c) Adjustment and replacement of working parts, and
- d) Safety arrangement.

7.2 Checking of Constructional Material

The material of construction of various components of the decorticators shall be checked and reported in the data sheet given in Annex B.

7.3 Visual Observations and Checking of Provision for Adjustments

The observations and adjustments shall be made and reported in the data sheet given in Annex C.

8 TEST AT NO-LOAD

8.1 Installation

Decorticator shall be installed on a level and preferably on hard surface. A suitable prime mover, preferably an electric motor of the size, recommended by the manufacturer shall be used to run the power operated decorticator. An energy meter or watt meter or an appropriate transmission dynamometer shall be used. Otherwise consumption of fuel shall be measured for the engine. The power delivered to the decorticator driven units may be supplied in the following ways:

- a) Direct coupling of the prime mover with the main shaft of the decorticator; and
- b) Connecting the prime mover with the help of flat or V-belt and pulley with the main shaft of the decorticator.

8.1.1 In case of (a), the power delivered would be the power output of the motor; whereas in case of (b), allowance for flat or V-belt drive losses may be taken as 6 and 3 percent respectively.

8.2 Running-in and Preliminary Adjustment

Before commencing the test, the decorticator shall be run-in for at least half an hour for power operated and 15 min for manually operated at the specified rpm/reciprocating speed. Various adjustment should be done as per the manufacturer's recommendation.

8.3 Energy Consumption

The decorticator shall be run at no-load for 30 min for power operated and 15 min for manually operated at the specified rpm/reciprocating speed and record the readings of the energy meter at every 5 min. In case of watt meter, readings shall be recorded every one minute for 15 min.

8.4 Speed of Operation

Revolutions of prime mover, main shaft of decorticator and blower shall be measured by a tachometer and shall be reported in rpm. Reciprocating speed of decorticating unit and sieve shall be measured and reported in strokes/min.

8.5 Visual Observations

During and after the no-load test, the visual observations given in C-1 shall be made and recorded.

9 TEST AT LOAD

9.1 Short-Run Test

9.1.1 Test Material

Sufficient quantity (preferably 50 kg per batch) of groundnut of atleast two varieties of different sizes shall be taken (see 6). The quantity should be sufficient to conduct three tests of one hour with three replications for each variety. The material selected should meet the quality standard as mentioned in 6.2. The moisture content should be 8 to 10 percent or as specified by the manufacturer.

9.1.2 Operation and Collection of Data

The decorticator shall be operated at its specified speed and at appropriate clearance (7 to 13 mm) between shoe and sieve after achieving the normal steady state operation at three different feed rates preferably 90, 100 and 110 percent of the capacity declared by the manufacturer for each of the two varieties of different sizes with three replications. Each test should be of one hour.

During the test period, the appropriate size of samples

at all outlets shall be collected three times at equal intervals. Reciprocating speed of decorticating unit and the reading of energy meter or dynamometer shall also be noted three times at equal intervals. The time for collection of samples shall be recorded accurately. At the end of the feeding, the decorticator shall be run idle for sometime to ensure that all the fed material had come out of the machine. At the end of the test, the material shall be collected and weighed. The mass of samples shall be added to them. The items to be measured, observed and calculated are:

- Mass of pod fed at inlet, main kernel mixture, sieve over-flow.
- Mass of decorticated whole kernel, damaged kernel, undecorticated and partially decorticated pod, shell and foreign matter in the sample from all outlets.
- Feed rate.
- Output capacity.
- Power required or fuel consumption.
- Revolution or reciprocating speed of decorticating unit.
- Undue vibration.
- Labour requirement.
- Ease of operation and adjustment.

The data shall be recorded in accordance with Annex D.

9.1.3 Performance of Decorticator

From the analysis of samples and sampling time, performance of decorticator, that is, decorticating efficiency, cleaning efficiency, damaged kernel percent, blown kernel and percentage of shelled whole kernel shall be determined in accordance with Annex E.

9.1.4 Energy Consumption

Energy consumption for decortication shall be specified in the form of specific energy as follows:

$$E_{sp} = \frac{1}{Q} [(P_L \times n_L) - (P_{NL} \times n_{NL})]$$

where

E_{sp} = specific energy for decortication, W.h/kg;

Q = throughput of the machine, kg/h;

P_L = watt meter reading (average) at load, W;

n_L = efficiency of prime mover at load (assume 0.90 if not specified);

P_{NL} = watt meter reading (average) at no-load, W; and

n_{NL} = efficiency of prime mover at no-load (assume 0.50 if not specified).

9.1.5 Rated Capacity

Select the feed rate at which specific energy (see 9.1.4) requirement of the machine (for decortication) and breakage percentage are minimum and at the same time, the machine runs without much noise and any problems.

9.2 Long-Run Test

The decorticator shall be operated for a minimum

period of 24 h at load. This period shall be covered in a maximum of 6 continuous runs of 4 h each. During and after operation, record of breakdowns, defects developed and repairing made shall be done.

9.3 Germination Test (Other Test)

Take 100 whole kernals obtained from main outlet of decorticator, and conduct the germinated test in accordance with Annex B of IS 6894.

ANNEX A

(*Clauses 5 and 7.1*)

SPECIFICATION SHEET FOR DECORTICATOR

A-1 PHOTOGRAPH OF DECORTICATOR

Line diagram and/or photograph of the whole view of the machine should be attached here.

A-2 SPECIFICATIONS

A-2.1

- a) Type of machine (manually or power operated, with sieve, fan, built-in prime mover);
- b) Make;
- c) Model;
- d) Serial No.;
- e) Year of manufacture; and
- f) Manufacturer's address.

A-2.2 Crops for which the machine is suitable.

A-2.3 Overall Dimensions

<i>Dimension</i>	<i>At Operation</i>	<i>At Transportation</i>
a) Length, mm		
b) Width, mm		
c) Height, mm		
d) Mass, kg		

A-2.4 Power Unit

- a) Type of prime mover
- b) Recommended power (kW)
- c) Type of drive

A-2.5 Power Transmission System

A-2.6 Decortivating Unit

- a) Type
- b) Constructional features
- c) Dimensions of main parts
- d) Rated revolution per minute(rpm) or reciprocating speed (strokes/min) and length of stroke of decortivating unit
- e) Number and size of spike or peg/raspsbar/slot/roll
- f) Spacing between two pegs

A-2.7 Concave or Slot

- a) Type
- b) Range of concave or slots clearance
- c) Methods of clearance adjustment

A-2.8 Sieve

- a) Type
- b) Number
- c) Sieve clearance (vertical distance between two successive sieves), mm
- d) Screen slope range
- e) Recommended screen slope
- f) Number of available sieves of different holes

A-2.9 Blower

- a) Number
- b) Type
- c) Method for changing air volume

A-2.10 Elevator

- a) Type
- b) Constructional feature
- c) Height of material spout

A-2.11 Crop Feeding and Hopper

- a) Method of feeding
- b) Capacity of hopper, m³
- c) Height of hopper from ground, m
- d) Recommended optimal feed rate, kg/h
- e) Method of adjustment of feeding rate

A-2.12 Transport Device

- a) Type
- b) Number, type and size of wheel

A-2.13 Safety Device (if any) and Arrangement

A-2.14 Labour requirement for feeding, supply of crop to feeder, collecting and bagging of kernels, disposal of other outlets.

A-2.15 Output Capacity

A-2.16 Others

ANNEX B

(Clause 7.2)

DATA SHEET FOR MATERIALS OF CONSTRUCTION

<i>Sl No.</i>	<i>Component</i>	<i>Material and Specifications</i>	<i>Sl No.</i>	<i>Component</i>	<i>Material and Specifications</i>
1.	Body/Frame		6.	Shoe	
2.	Handle		7.	Concave or slot	
3.	Decorticating unit		8.	Blower	
4.	Sieve		9.	Elevator	
5.	Hopper				

ANNEX C

(Clauses 7.3 and 8.5)

DATA SHEET FOR VISUAL OBSERVATION AND ADJUSTMENTS**C-1 OBSERVATIONS**

- a) Adequacy of protection of bearings against ingress or dust
- b) Adequacy of safety arrangements
- c) Provision for lubrication
- d) Provision for easy changing of components requiring replacements
- e) Loosening of fasteners
- f) Slippage of the belts
- g) Undue noise from any components
- h) Undue vibration

j) Other observations**C-2 ADJUSTMENTS**

- a) Feed-rate
- b) Revolution of prime mover, main shaft
- c) Clearance between components of shelling unit
- d) Sieve size, stroke and its inclinations
- e) Speed of blower
- f) Reciprocating speed of decorticating unit

ANNEX D

(Clause 9.1.2)

DATA SHEET FOR PERFORMANCE TEST**DATE OF TEST :****LOCATION OF TEST :****D-1 PRE TEST OBSERVATIONS**

- | | | |
|-------------------------|-----|------|
| a) Variety of groundnut | (i) | (ii) |
| i) length, mm | | |
| mean, mm | | |
| standard deviation, mm | | |
| ii) width/diameter, mm | | |
| mean, mm | | |
| standard deviation, mm | | |

- iii) breadth, mm
- mean, mm
- standard deviation, mm
- iv) weight of a pod, g
- mean weight, g

- b) Moisture content of groundnut pod and kernel
 - i) pod (%)
 - ii) kernel (%)
- c) Kernel ratio (%)
- d) Percentage of damaged pods in the feed (%)
- e) Germination percent before run test (%)

D-2 TEST AT NO-LOAD

- a) Adjustment of working parts
 - i) concave or slot clearance, mm
 - ii) blower inlet
 - iii) sieve and their inclinations
 - iv) others
- b) Revolution or reciprocating speed
 - i) prime mover, rpm
 - ii) decorticating unit rev/min or strokes/min
 - iii) mean linear speed
 - iv) air velocity at blower outlet, m/s
- c) Condition of operation
 - i) kind of prime mover
 - ii) feeding method
 - iii) number and role of workers
- d) Condition of workers
 - i) skill of workers
 - ii) excellent/good/satisfactory/unsatisfactory
- e) i) energy consumption measurement method/instrumentation for measuring energy consumption
 - ii) fuel consumption, litres
- f) Breakdown, repair, replacement of parts

D-3 TEST AT LOAD

- a) Date of test
- b) Actual operating time, min
- c) Time lost owing to
 - i) adjustment, min
 - ii) others (give details), min
- d) Power required, kW
- e) Fuel consumption, l/h
- f) Total weight of pod fed, kg
- g) Feed rate of pod, kg/h
- h) Feed rate of kernel, kg/h (calculated)
- j) Total weight at main kernel outlet, kg
- k) Content (percentage) by mass
 - i) whole kernel (%)
 - ii) damaged kernel (%)
 - iii) undecorticated and partially decorticated pod (%)
 - iv) foreign matter (%)
 - v) output (of shelled kernel) (%)
- m) Total weight at sieve overflow outlet, kg
- n) Content (percentage) by mass
 - i) whole kernel (%)
 - ii) damaged kernel (%)
 - iii) undecorticated and partially decorticated pod (%)

- iv) foreign matter (%)
- p) Total weight at shell outlet, kg
- q) Content (percentage) by mass
 - i) whole kernel (%)
 - ii) broken kernel (%)
 - iii) undecorticated and partially decorticated pod (%)
 - iv) foreign matter (%)
- r) Decorticating efficiency (%)
- s) Cleaning efficiency for the machine with blower and sieve (%)
- t) Percentage of damaged kernel (%)
- u) Percentage of blown kernel for the machine with blower (%)
- v) Percentage of decorticated whole kernel with respect to decorticated kernel at main outlet (%)
- w) Observations on machine
- x) Effectiveness of decorticating function
 - i) vibration
 - ii) clogging or other deficiency of flow
 - iii) other observations
- y) Labour requirement
 - i) Number of persons employed
 - 1) feeding
 - 2) collecting and bagging kernel
 - 3) others (to be specified)
 - ii) Total labour requirement
 - 1) at test, person/h
 - 2) per tonne of kernel, person-h/tonne
- z) Ease of operation
 - i) ease of feeding
 - ii) dust around machine
 - iii) adjustment
 - iv) safety
 - v) others

D-4 LONG-RUN TEST AND OTHER TESTS

- a) Total running time
- b) Continuous running time
- c) Breakdown, repair, replacement of parts during test
- d) Any other observations and remarks, if any

D-5 GERMINATION TEST

- a) number of seeds placed in petridish
- b) number of seeds germinated after completion of incubation period
- c) percentage of germination
- d) mean (percentage of germination)

ANNEX E

(Clause 9.1.3)

DETERMINATION OF PERFORMANCE OF DECORTICATOR

E-1 A known weight of groundnut is taken and is fed into groundnut decorticator for shelling. The time taken for the operation is noted. The shells and unshelled pods collected in the shell outlet are separated manually and weighed. The kernel, unshelled pods and shell which are collected in the kernel outlet are also separated and weighed. The watt meter connected in the electrical circuit is used to calculate the energy requirement.

E-1.1 Out-Turn (Capacity)

$$C = W/t$$

where

C = capacity of machine, kg/h;

W = weight of groundnut pods fed in the machine, kg; and

t = time taken for decortication, h.

E-1.2 Decortivating Efficiency

Decortivating efficiency, percent = $(1 - W_u/w) \times 100$

where

W_u = weight of undecorticated pods, kg; and

w = total weight of pods fed in the machine, kg.

E-1.3 Breakage

$$\text{Breakage, percent} = \frac{W_b \times 100}{W_g + W_b}$$

where

W_b = weight of broken kernels, kg; and

W_g = weight of good kernels, kg.

E-1.4 Specific Energy Requirement

$$E = K/W$$

where

E = energy requirement per kg of pods, kW.h/kg;

K = energy meter reading, kW.h; and

W = weight of pods decorticated, kg.

E-1.5 Separation Efficiency

$$\text{Separation Efficiency} = \frac{ad - bc}{(a + c)(b + d)}$$

where

a = weight of kernels in the kernel outlet, kg;

b = weight of shells in the kernel outlet, kg;

c = weight of kernels in the shell outlet, kg; and

d = weight of shells in the shell outlet, kg.

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